ORIGINAL RESEARCH

Assessing the Effectiveness of 0.75% Ropivacaine via Epidural Neuraxial Blockade for Lower Abdominal Surgeries

[1]Kanhaiya Kumar, [2]Rishikesh, [3]Nazia Tarannum

[1-3]Senior Resident, Department of Anaesthesia, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

Correspnding Author
Nazia Tarannum
Senior Resident, Department of Anaesthesia, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

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ABSTRACT

Objective: This prospective observational study aimed to evaluate the efficacy and safety of 0.75% ropivacaine administered via epidural neuraxial blockade for pain management in patients undergoing lower abdominal surgeries. **Methods:** A total of 100 adult patients scheduled for elective lower abdominal surgeries at the Indira Gandhi Institute of Medical Sciences, Patna, were enrolled in the study. Pain intensity, total postoperative opioid consumption, hemodynamic stability, adverse events, time to ambulation, and readiness for discharge were assessed as primary and secondary outcome measures. **Results:** Significant reductions in pain intensity scores were observed over time, with mean scores decreasing from 3.4 at 1 hour to 1.6 at 24 hours postoperatively. Median total opioid consumption was 12 mg (interquartile range: 8-16 mg), indicating moderate opioid requirements. Hemodynamic stability was maintained throughout the perioperative period, and no severe adverse events were reported. The median time to ambulation was 8 hours, with a median time to readiness for discharge of 12 hours. **Conclusion:** 0.75% ropivacaine epidural anesthesia demonstrated effective pain relief, opioid-sparing effects, hemodynamic stability, and a favorable safety profile in patients undergoing lower abdominal surgeries. This approach holds promise for optimizing perioperative care and promoting early recovery in this surgical population.

Keywords: Ropivacaine, Epidural anesthesia, Neuraxial blockade, Lower abdominal surgeries

INTRODUCTION

The management of postoperative pain remains a cornerstone of patient care following lower abdominal surgeries, as effective pain control significantly enhances patient comfort, recovery speed, and overall satisfaction [1]. Lower abdominal procedures—encompassing a wide range of surgeries such as appendectomies, hernia repairs, and various gynecological operations—pose specific challenges due to the sensitivity of the surgical site and the integral functions of the abdominal muscles that are affected during recovery [2,3].

Amid the array of pain management techniques, the epidural neuraxial blockade has emerged as a particularly effective method [4]. This technique involves the administration of local anesthetics directly into the epidural space, which lies outside the dural membrane of the spinal cord, to obstruct nerve signal transmission in the lower body [5]. This method not only alleviates pain but also minimizes the systemic side effects often associated with oral or intravenous pain medications [6].

Ropivacaine, a local anesthetic belonging to the amino amide class, is frequently selected for epidural anesthesia due to its favorable pharmacological profile, which includes a potent analgesic effect with a relatively low risk of motor blockade [7]. This balance is crucial for postoperative recovery as it allows for earlier mobilization of the patient and less interference with the rehabilitation process. The use of ropivacaine in a 0.75% concentration is of particular interest due to its effectiveness in providing profound sensory block without extensive motor impairment, facilitating not only comfort but also functional recovery [8].

The primary objective of this study is to rigorously assess the efficacy and safety of 0.75% ropivacaine when used in epidural neuraxial blockade for patients undergoing lower abdominal surgeries. By evaluating parameters such as pain intensity, opioid consumption (and thereby the potential reduction of opioid-related side effects), hemodynamic stability, incidence of adverse events, and milestones such as time to ambulation and readiness for discharge, the study aims to enrich the existing body of knowledge

concerning postoperative pain management. Such information could critically inform best practices, leading to optimized patient outcomes and potentially setting new standards for anesthesia care in abdominal surgeries.This sets the stage for a comprehensive exploration into the use of 0.75% ropivacaine, underscoring the clinical relevance and potential benefits of this anesthetic approach in the context of enhancing perioperative patient care and recovery.

MATERIAL AND METHODOLOGY

The methodology for this study was meticulously designed to evaluate the efficacy and safety of 0.75% ropivacaine administered via epidural neuraxial blockade in patients undergoing lower abdominal surgeries. The study adopted a prospective observational approach, ensuring the systematic collection and analysis of data. Here is a detailed breakdown of the study design, setting, participant selection, and various methodologies employed:

Study Design

This research was structured as a prospective observational study to collect real-time data on the effects of 0.75% ropivacaine when used in epidural anesthesia for lower abdominal surgeries. The observational nature of the study aimed to capture outcomes in a naturalistic setting, providing insights into the clinical application and effectiveness of the analgesic regimen.

Study Setting

The study was conducted at the Indira Gandhi Institute of Medical Sciences (I.G.I.M.S.), Patna, Bihar, India. This setting was chosen due to its high volume of abdominal surgeries, which allowed for adequate sample size and diversity. The study spanned one year, from March 2022 to March 2023, providing a robust timeframe to capture seasonal variations in surgical schedules and patient demographics.

Participant Selection

A total of 100 adult patients scheduled for elective lower abdominal surgeries were enrolled in the study. The inclusion criteria were adults aged 18 years and older who were undergoing surgery requiring epidural anesthesia. Exclusion criteria included patients with contraindications to epidural anesthesia (such as coagulopathies or infections at the injection site), known allergies to ropivacaine, pre-existing neurological deficits, or inability to provide informed consent.

Data Collection

Before surgery, demographic data such as age, gender, and medical history were collected for each participant. Baseline vital signs including blood pressure, heart rate, respiratory rate, and oxygen saturation were recorded. These initial data points served to establish a baseline for comparing intraoperative and postoperative changes.

Epidural Anesthesia Technique

Epidural anesthesia was administered by experienced anesthesiologists using standardized procedures. The technique involved:

1. **Locating the Epidural Space:** A 17-gauge Tuohy needle was used to locate the epidural space at the appropriate vertebral level.
2. **Catheter Insertion:** Once the epidural space was confirmed via the loss of resistance technique, an epidural catheter was inserted.
3. **Drug Administration:**After confirming the correct placement of the catheter via a test dose, 0.75% ropivacaine was administered in incremental doses until the desired sensory blockade was achieved, ensuring adequate analgesia for the surgical procedure.

Outcome Measures

Primary Outcome: Pain intensity was assessed using a numerical rating scale (NRS) from 0 (no pain) to 10 (worst imaginable pain). Pain assessments were conducted at 1, 6, 12, and 24 hours postoperatively to evaluate the analgesic effectiveness of the epidural blockade.

Secondary Outcomes:

- Total postoperative opioid consumption, measured in morphine equivalent doses to assess the opioid-sparing effect of the epidural ropivacaine.
- Hemodynamic stability, is assessed by monitoring blood pressure and heart rate during and after the procedure.
- Incidence of adverse events such as hypotension, bradycardia, respiratory depression, and neurological complications.
- Time to ambulation and readiness for discharge, which were recorded to evaluate recovery speed.

Data Analysis

The data collected were analyzed using appropriate statistical methods. Descriptive statistics summarized demographic and clinical characteristics, while inferential statistics (such as t-tests, chi-square tests, and non-parametric tests) were employed to compare outcomes across different time points and between demographic groups. A p-value of less than 0.05 was considered statistically significant, indicating that the results were unlikely to be due to chance.

RESULTS

Participant Characteristics

A total of 100 patients (n=100) undergoing elective lower abdominal surgeries under epidural anesthesia with 0.75% ropivacaine were included in the study. The mean age of participants was 45.2 years (SD ± 10.8), with a slight male predominance (55%).

Primary Outcome

Pain Intensity:

The mean pain scores at various postoperative time points (1, 6, 12, and 24 hours) were as follows: 1 hour: 3.4 (SD ± 1.2), 6 hours: 2.8 (SD ± 1.0), 12 hours: 2.2 (SD ± 0.9), and 24 hours: 1.6 (SD ± 0.7). Pain scores significantly decreased over time ($p < 0.001$), indicating effective pain relief with 0.75% ropivacaine epidural anesthesia.

Secondary Outcomes

1. Total Postoperative Opioid Consumption:

The median total opioid consumption (morphine equivalent dose) was 12 mg (interquartile range: 8-16 mg), reflecting moderate opioid requirements in the postoperative period.

2. Hemodynamic Stability:

No significant changes in blood pressure or heart rate were observed intraoperatively or postoperatively, indicating adequate hemodynamic stability with 0.75% ropivacaine epidural anesthesia.

3. Incidence of Adverse Events:

There were no reports of severe adverse events such as hypotension, bradycardia, or respiratory depression. Minor adverse events such as pruritus at the epidural site were reported in 5% of patients, which resolved spontaneously without intervention.

4. Time to Ambulation and Readiness for Discharge:

The median time to ambulation was 8 hours (interquartile range: 6-10 hours), while the median time to readiness for discharge from the recovery room was 12 hours (interquartile range: 10-14 hours), indicating timely recovery and discharge readiness following lower abdominal surgeries with 0.75% ropivacaine epidural anesthesia.

Overall, the findings suggest that 0.75% of ropivacaine administered via epidural neuraxial blockade provides effective pain relief with minimal adverse effects, facilitating early ambulation and postoperative recovery in patients undergoing lower abdominal surgeries.

Table 1: The primary and secondary outcome measures observed at various time points during the study, provide a clear overview of the findings regarding the efficacy and safety of 0.75% ropivacaine epidural anesthesia in lower abdominal surgeries.

Outcome Measure	Time Point	Mean / Median Value	Standard Deviation (if applicable)
Pain Intensity (NRS)	1 hour	3.4	± 1.2
	6 hours	2.8	± 1.0
	12 hours	2.2	± 0.9
	24 hours	1.6	± 0.7
Total Postoperative Opioid Consumption	-	Median: 12 mg	Interquartile Range: 8-16 mg
Hemodynamic Stability	-	Stable throughout	-
Incidence of Adverse Events	-	None reported	-
Time to Ambulation	-	Median: 8 hours	Interquartile Range: 6-10 hours
Time to Readiness for Discharge	-	Median: 12 hours	Interquartile Range: 10-14 hours

DISCUSSION

The results from this study on the efficacy and safety of 0.75% ropivacaine administered via epidural neuraxial blockade for pain management in lower abdominal surgeries offer several crucial insights into the anesthetic's performance and its implications for clinical practice. This detailed examination integrates the study's findings with the broader body of existing medical literature, offering a comprehensive analysis that underscores the benefits and potential limitations of using 0.75% ropivacaine in this context [8,9].

The results demonstrated a significant reduction in pain scores over time from 1-hour post-operation to 24 hours. This trend is consistent with existing research indicating that ropivacaine provides effective analgesia suitable for postoperative pain management, particularly in abdominal surgeries where pain control is pivotal for recovery. The sustained decrease in pain scores not only signifies the potency of ropivacaine but also highlights its role in enhancing patient comfort, an essential factor for early postoperative recovery. These findings align with studies such as those by Inugala et al. (2016) and Sharma et al. (2019), which have also noted the effective analgesic properties of ropivacaine in similar surgical settings [1,4,10,11].

An important aspect of this study was the moderate opioid consumption among patients, which underscores ropivacaine's opioid-sparing effect [12]. Reducing opioid use in postoperative care is a critical goal in anesthesia, as it decreases the risk of opioid-related side effects, such as nausea, vomiting, and respiratory depression. This opioid-sparing effect not only enhances patient safety but also contributes to quicker postoperative mobilization and discharge readiness, thus promoting a faster return to normal activities and reducing hospital stay lengths [13,14].

Hemodynamic parameters remained stable throughout the perioperative period for patients administered ropivacaine, suggesting that the drug does not adversely affect blood pressure or heart rate significantly [15]. This stability is crucial in surgical settings, particularly for patients who might be at risk of cardiovascular complications. The absence of

significant hemodynamic disturbances indicates that ropivacaine can be safely used in a diverse patient population, including those with varying degrees of cardiovascular health [16].

The safety of 0.75% ropivacaine was further confirmed by the low incidence of adverse events. No severe complications such as hypotension, bradycardia, or respiratory depression were reported. The minor adverse events observed were mostly localized, such as pruritus at the epidural insertion site, which resolved without intervention [17]. This favorable safety profile is consistent with the pharmacological properties of ropivacaine, which is known for its lower lipid solubility and reduced central nervous system and cardiotoxic potential compared to bupivacaine, as detailed in studies by Gottschalk et al. (2002) and Najib et al. (2016) [9,10,18].

While the findings are promising, several limitations need acknowledgment. The observational nature of the study restricts the ability to draw causal inferences from the observed associations. Additionally, being a single-center study, the results may not be universally generalizable across different settings or populations. The absence of a control group limits comparative analysis with other concentrations of ropivacaine or different anesthetic agents.

Future research should focus on addressing these limitations by designing randomized controlled trials that involve multiple centers and diverse patient demographics. Comparative studies that evaluate different concentrations of ropivacaine or compare ropivacaine with other local anesthetics could provide deeper insights into optimizing perioperative pain management strategies.

CONCLUSION

This detailed discussion confirms that 0.75% ropivacaine offers effective analgesia with an excellent safety profile for patients undergoing lower abdominal surgeries. Its opioid-sparing effects and hemodynamic stability are particularly advantageous, facilitating early postoperative recovery and potentially transforming standard care practices in perioperative pain management.

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